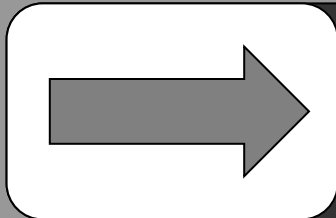


Wed Nov 5<sup>th</sup> 2014.

CIVL 498C Life Cycle Assessment

# Week 10: Scaling, Resources and Emerging Topics in LCA



slide to unlock

# Presentation Outline

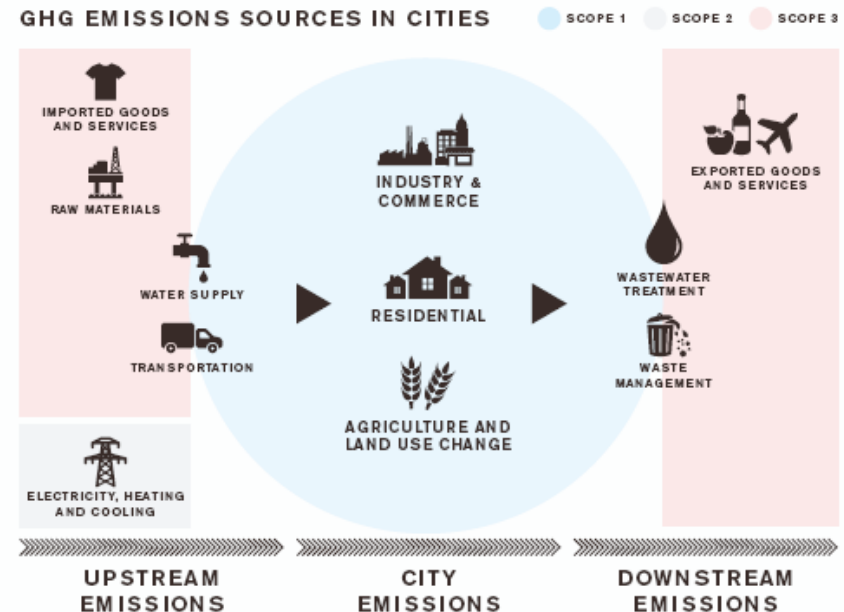
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- 1. Scaling LCA from Construction Products to Cities**
2. Tools, Databases and Resources
3. Emerging Topics

# PAS 2070 system boundaries:

- **Scope 1** - All direct GHG emissions sources from activities taking place within the city boundary.
- **Scope 2** - Energy-related indirect GHG emissions that result as a consequence of use of grid-supplied electricity, heating and/or cooling, within the city boundary .
- **Scope 3** - All other [i.e. other than Scopes 1 and 2] indirect GHG emissions that occur as a result of activities within the city boundary.

Figure 1 – GHG emissions sources in cities in relation to Scope 1, 2 and 3



SOURCE Adapted from Figure 1 of Carbon footprinting for climate change management in cities [6].

Table 1 – PAS 2070 GHG emission sources categories

PAS 2070 category	
Stationary – fuel combustion in buildings and facilities and for energy generation	(see 7.2)
Mobile – fuel combustion for transport	(see 7.3)
Industrial processes and product use (IPPU)	(see 7.4)
Agriculture, forestry and other land use (AFOLU)	(see 7.5)
Waste and wastewater treatment	(see 7.6)
Goods and services – water provision, food and drink and construction materials	(see 7.7)

## 7.7 Goods and services

### 7.7.3 Construction materials

#### 7.7.3.1 Assessment boundary

Cradle to gate GHG emissions from use of cement and steel materials within the city boundary shall be included in the assessment.

*NOTE Other construction materials are covered by the material contribution threshold in 7.7.4.*

#### 7.7.3.2 Data

7.7.3.2.1 Activity data shall be collected for either:

- the quantity (mass or volume) of cement and steel materials consumed within the city boundary during the assessment year; or
- the expenditure on cement and steel materials within the city boundary during the assessment year.

Table 2 – List of data to be collected and recorded in the PAS 2070 assessment re

Data	
General	
1	Definition of the city boundary
2	Time period of assessment
3	Data completeness, consistency, reproducibility, data sources
4	Emission factors: <ul style="list-style-type: none"> <li>Time relevance</li> <li>Geographic relevance</li> <li>Sources</li> </ul>
5	Activity data
6	Any assumptions made
7	Supplementary data to provide context
DPSC methodology	
A	Stationary sources of GHG emissions <ul style="list-style-type: none"> <li>1 Direct GHG emissions from fuel combustion</li> <li>2 Indirect GHG emissions from generation of grid-supplied electricity, district heating or cooling</li> <li>3 Direct GHG emissions from generation of grid-supplied electricity, district heating or cooling</li> <li>4 Indirect GHG emissions from upstream activities</li> </ul>
B	Mobile sources of GHG emissions <ul style="list-style-type: none"> <li>1 Direct GHG emissions from inboundary transport of goods and people</li> <li>2 Indirect GHG emissions from inboundary transport of goods and people</li> <li>3 Indirect GHG emissions from transboundary transport of goods and people</li> <li>4 Indirect GHG emissions from upstream activities</li> </ul>
C	Industrial processing and product use (IPPU) <ul style="list-style-type: none"> <li>1 GHG emissions from industrial processes</li> <li>2 GHG emissions from product use</li> </ul>

D	Agriculture, forestry and other land use (AFOLU) <ul style="list-style-type: none"> <li>1 GHG emissions where there is no land-use change (LUC)</li> <li>2 GHG emissions from land-use change (LUC)</li> <li>3 GHG emissions from food production</li> </ul>
E	<del>(F)</del> Waste and <del>(G)</del> wastewater treatment <ul style="list-style-type: none"> <li>1 GHG emissions from waste</li> <li>2 GHG emissions from wastewater treatment</li> </ul>
F	Goods and services <ul style="list-style-type: none"> <li>1 GHG emissions from water provision</li> <li>2 GHG emissions from food and drink</li> <li>3 GHG emissions from construction materials</li> <li>4 Goods and services that make a material contribution to city GHG emissions</li> </ul>
Total GHG emissions for the city calculated in accordance with DPSC methodology	

Data	
CB methodology	
A	EEIO model used
B	Economic final consumption by households: <ul style="list-style-type: none"> <li>1 Food and drink</li> <li>2 Utility services</li> <li>3 Household</li> <li>4 Transport services</li> <li>5 Private services</li> <li>6 Other goods and services</li> </ul>
C	Economic final consumption by municipal and national government
D	Economic final consumption by business capital expenditure
Total GHG emissions for the city calculated in accordance with the CB methodology	

\*DPSC – direct plus supply chain, allocate GHGs to producing activities.

\*\*CB – consumption based, allocate GHGs produced to consumers (exports are excluded).

# Presentation Outline

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1. Scaling LCA from Construction Products to Cities
- 2. Tools, Databases and Resources**
3. Emerging Topics

# Tools

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- LCA practitioner tools
  - OpenLCA - <http://www.openlca.org/>
  - SimaPro - <http://www.pre-sustainability.com/simapro>
  - GaBi - <http://www.gabi-software.com/canada/index/>
- Building design LCA tools
  - Impact Estimator - <http://calculatelca.com/>
  - BIRDS - [http://www.nist.gov/el/economics/20141007\\_birds.cfm](http://www.nist.gov/el/economics/20141007_birds.cfm)
  - BEES - <http://www.nist.gov/el/economics/BEESSoftware.cfm>
  - Tally - <http://www.choosetally.com/>
- Excel...

# LCI Databases

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- LCI Databases

- Athena LCI Database - <http://www.athenasmi.org/our-software-data/lca-databases/>
- US LCI - <https://www.lcacommons.gov/nrel/search>
- ELCD - <http://lca.jrc.ec.europa.eu/lcainfohub/datasetArea.vm>
- Ecoinvent - <http://www.ecoinvent.org/database>
- GaBi - <http://www.gabi-software.com/databases>



# Resources

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- Other LCA Databases
  - ICE Database (focused on building material and energy/GHG) - <http://www.circularecology.com/embodied-energy-and-carbon-footprint-database.html#.VFqNivnF8rU>
  - EPD Program Operators
    - CSA - [http://www.csaregistries.ca/epd/about\\_epd\\_pcrs\\_e.cfm](http://www.csaregistries.ca/epd/about_epd_pcrs_e.cfm)
    - NRMCA - <http://www.nrmca.org/sustainability/EPDProgram/Index.asp>
    - UL Environment - <http://productguide.ulenvironment.com/SearchResults.aspx?CertificationID=15&pageNumber=1>
    - FP Innovations - [https://fpinnovations.ca/ResearchProgram/environment-sustainability/epd-program/Pages/default.aspx#.VCMcK\\_IdUrU](https://fpinnovations.ca/ResearchProgram/environment-sustainability/epd-program/Pages/default.aspx#.VCMcK_IdUrU)
    - CalStar - <http://calstarproducts.com/epd/>
    - ASTM - [http://www.astm.org/CERTIFICATION/filtrexx40.cgi?-P+PROG+7+cert\\_detail.frm](http://www.astm.org/CERTIFICATION/filtrexx40.cgi?-P+PROG+7+cert_detail.frm)
    - SCS Global - <http://www.scsglobalservices.com/environmental-product-declaration>
    - Environdec - <http://www.environdec.com/>

# Resources

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- Resources
  - LCA Alliance - <http://lcaalliance.com/lca-links/>
  - PRe Discussion list - <http://www.pre-sustainability.com/lca-discussion-list>
  - Social media..

# facebook

life cycle assessment



## All Results



### Life Cycle Assessment

Community · 250 likes

Like



Like



### Life cycle assessment

Interest · Community Page · 210 likes

Like



Like



### LCA - Life Cycle Assessment

Community Organization · 342 likes

ORTUGA Like



Like



### Life Cycle Assessment Handbook by M. Curran

Book · 1 like

Like



Like



### Triangle Life Cycle Assessment

Raleigh, North Carolina · Consulting/Business Services · 4 likes

Like



Like



### International Life Cycle Academy

Passeig Pujades, 1 · Barcelona, Spain · 08003

Education

0 were here · 21 likes



Like



### Adca - American Center for Life Cycle Assessment

Non-Profit Organization · 17 likes

Like



Like



### Economic input-output life cycle assessment

Interest · Community Page · 2 likes

Like



Like



### ILCA - Indonesian Institute of Life Cycle Assessment on Food Business

Community · 6 likes



Like

05/11/2014

11



## Life Cycle Assessment [Member]

A Group to hold discussions about all things linked with LCA

**Active:** 34 discussions this month · 2,715 members



## Life Cycle Assessment - Sustainable Supply Chain, Euro...

The LCA Sustainable Supply Chain Europe Summit will provide a truly unique guide to LCA and the opportunity to learn how this tool can work as...

4 discussions this month · 388 members

View Submission and 76 in your network



## British Association of Life Cycle Assessment

The British Association of Life Cycle Assessment (BALCA) is the UK's professional organisation for people involved in the use, development and...

2 discussions · 13 members



## Life Cycle Assessment of Bioenergy Systems

As bioenergy continues to become a big topic of interest among policy makers, researchers and investors, it is imperative that the knowledge be...

2 discussions · 13 members

View Submission and 13 in your network



## Sustainability Life Cycle Assessment - Development Com...

This is a closed Development Community for Sustainable Life Cycle Assessment methods and tools, convened by The Natural Step and open to users of...

1 discussion · 8 members

View Submission and 1 in your network



## Life Cycle Association of New Zealand (LCANZ)

The Life Cycle Association of New Zealand (LCANZ) provides a focal point for Life Cycle Assessment and Management work conducted in New Zealand.

14 discussions · 42 members

View Submission and 42 in your network



## LCA and Environmental Assessment [Member]

The purpose of this group is creating a network of professionals... of Life Cycle Assessment principles and share knowledge and experience...

**Active:** 26 discussions this month · 1,044 members

View Submission and 400 in your network

# Presentation Outline

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# PCR Alignment

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## Functional Unit:

performance related reference to which input and output data are normalized

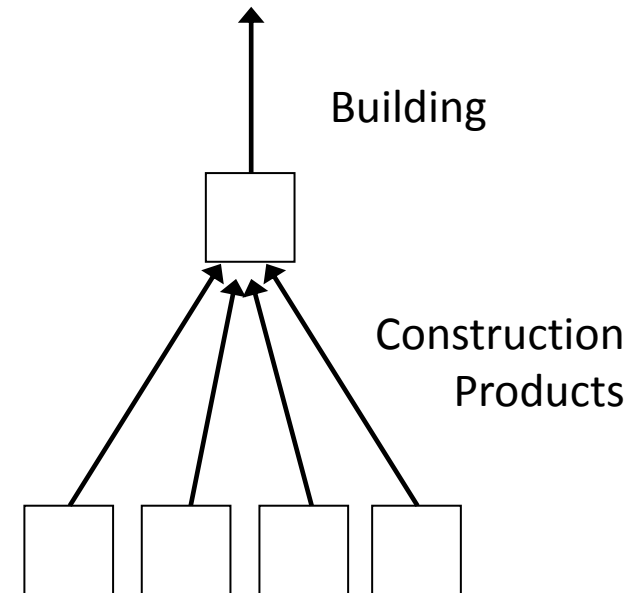
- per whole building
- per m<sup>2</sup> floor area

## Reference Flow:

outputs from system required to fulfill the function expressed by the functional unit.

## Intermediate Flow:

output from a process that is input to other process that requires further transformation within system.



# PCR Alignment

## NORTH AMERICAN SOFTWOOD LUMBER

AMERICAN WOOD COUNCIL  
CANADIAN WOOD COUNCIL

Table 3: Cradle-to-Gate Impact Assessment Results - 1m

Impact category indicator	Unit
Global warming potential	kg CO <sub>2</sub> eq.
Acidification potential	H+ moles eq.
Eutrophication potential	kg N eq.
Ozone depletion potential	kg CFC-11 eq.
Smog potential	kg O <sub>3</sub> eq.
<b>Total primary energy consumption</b>	<b>Unit</b>
Non-renewable fossil	MJ
Non-renewable nuclear	MJ
Renewable, biomass	MJ
Renewable, other	MJ
<b>Material resources consumption</b>	<b>Unit</b>
Non-renewable materials	kg
Renewable materials	kg
Fresh water	L
<b>Non-hazardous waste generated</b>	<b>Unit</b>
Solid waste	kg

## Concrete EPDs

### Environmental impacts

Impact name	Unit
Global warming potential	kg CO <sub>2</sub> -eq
Ozone depletion	kg CFC-11-eq
Acidification	kg SO <sub>2</sub> -eq
Eutrophication	kg N-eq
Photochemical oxidation	kg O <sub>3</sub> -eq
Primary energy consumption	MJ
Batch freshwater consumption	gal
Process freshwater consumption	gal

[www.carbonleadershipforum.org](http://www.carbonleadershipforum.org)

### Life Cycle Inventory Data

Total primary energy consumption	BTU (MJ)
Bio-mass/bio-fuel consumption (if any)	BTU (MJ)
Water Use (batch)	lb (kg)
Water Use (wash)	lb (kg)
Total waste disposed	lb (kg)

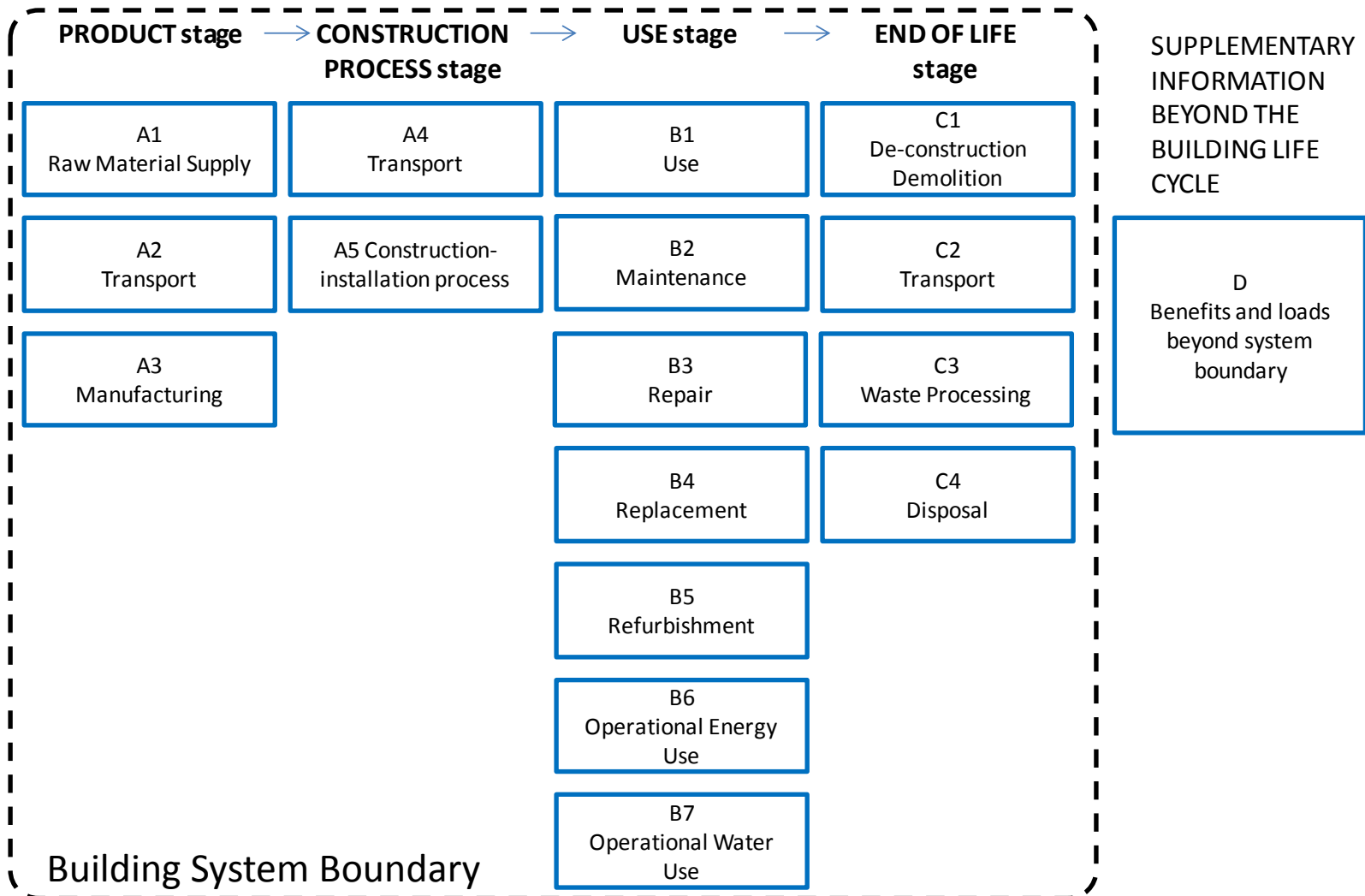
### Impact Category Indicators

Climate Change/'Carbon Footprint'	kg CO <sub>2</sub> eq
Ozone Depletion	kg CFC 11 eq
Acidification Air	kg SO <sub>2</sub> eq
Eutrophication Air	kg N eq (kgPO4)
Eutrophication Water	Kg N eq
Photochemical ozone creation/smog	Kg O <sub>3</sub> eq

# Data Structure Improvements

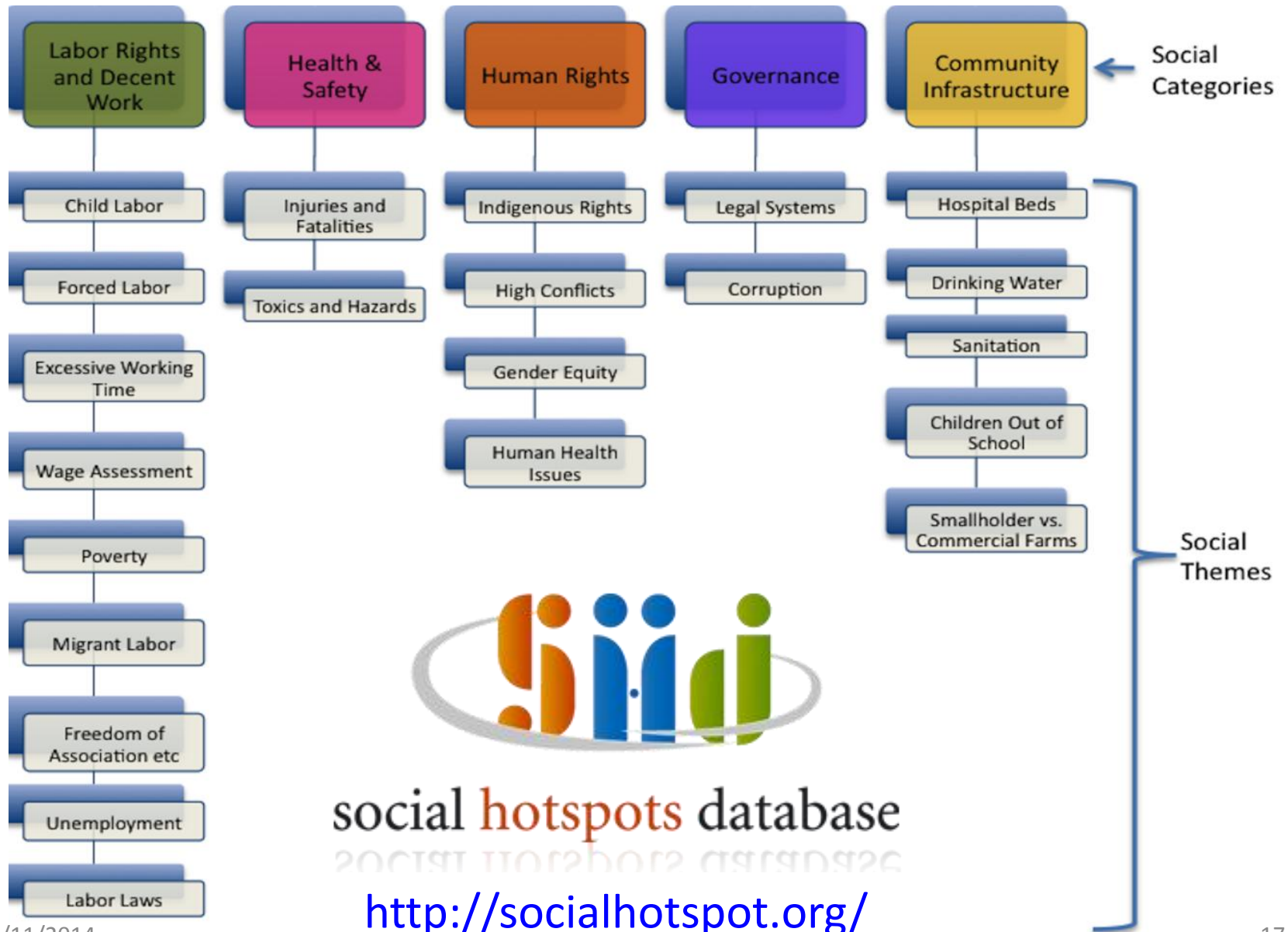
## Modular information structure

EN 15978 and 15804





# Emerging Social LCA Practice



# Broadening Adoption/Institution



[www.sustainabilityconsortium.org](http://www.sustainabilityconsortium.org)

TSC informs decision makers on **product sustainability** throughout the entire product life cycle **across all sectors.**



<http://www.coldstreamconsulting.com/life-cycle-analysis>



05/11/2014

# Professional Development

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## - Training for LEED?

date: Tue, Jan 22, 2013 at 4:29 PM

subject: APEGBC - Life-cycle assessment course

Hi Rob,

We met a while back (I think last year) at a GreenTech Exchange event at SFU Harbour Centre. Hope you are doing well.

I serve on APEGBC's Sustainability Committee; we are in the process of rolling out a new set of Sustainability Guidelines for professional engineers and geoscientists. As part of the rollout, this past summer we did a survey of our membership to establish what they perceived as gaps in their sustainability knowledge and ability to fully apply the guidelines at work.

The top response for tools/resources that members would like to see was: ***"How to prepare a lifecycle assessment that incorporates sustainability"***.

Our Education Subcommittee is starting to look for continuing professional development (CPD) courses to reinforce the guidelines, and respond to what members told us in the survey.

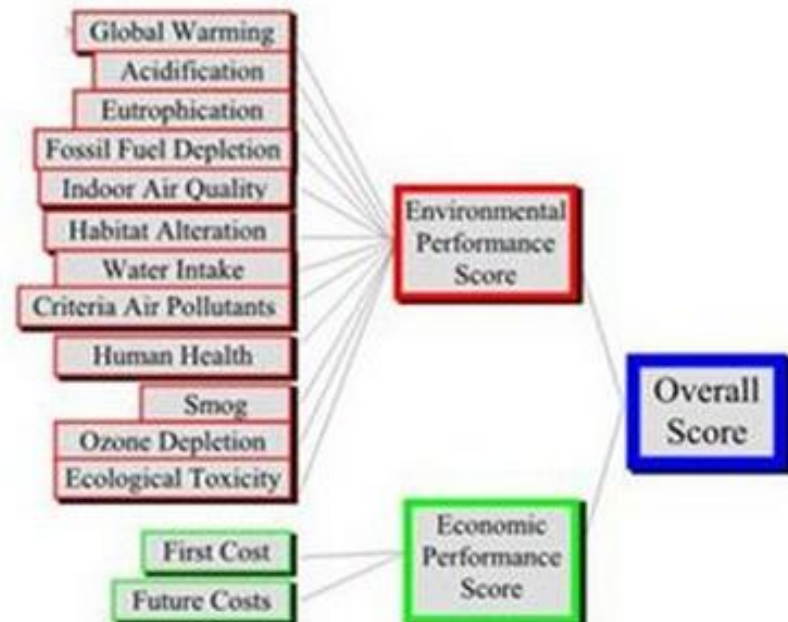
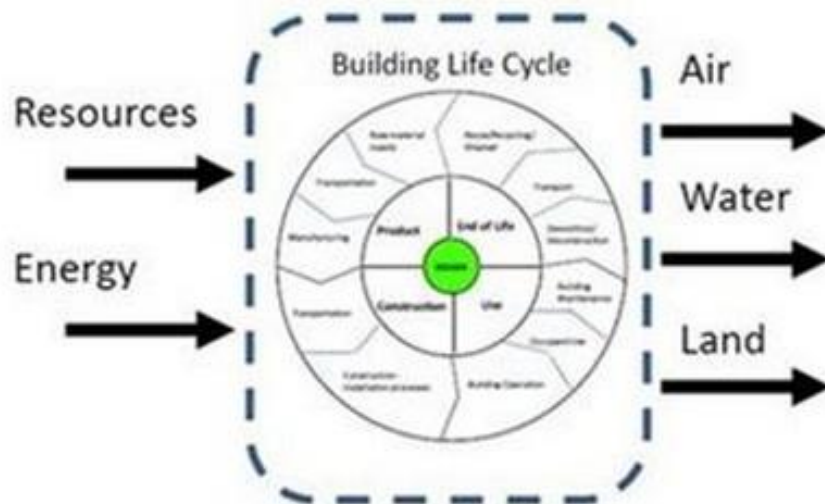
# Integrated Analysis

Confusion using terms LCA-LCC together..



Inventory Analysis

Impact Assessment





# Language

.. use of term  
life cycle  
approach to  
encompass  
LCA-LCC  
analyses.

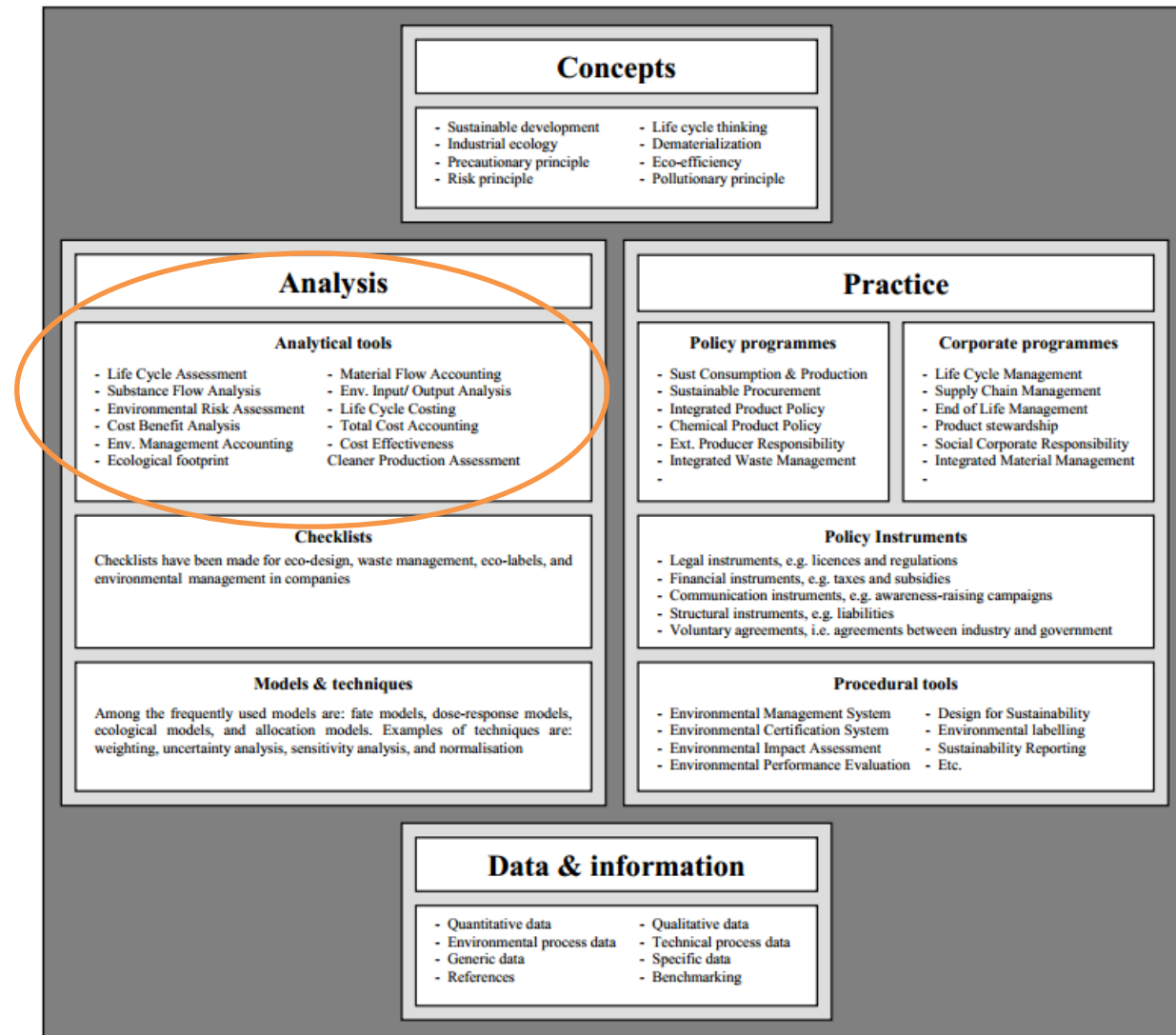


Figure 2: life cycle approaches, consisting of analysis and practice, are directed by concepts and supported by data and information (modified from Wrisberg et al., 2002).

# Information and Communication Technology

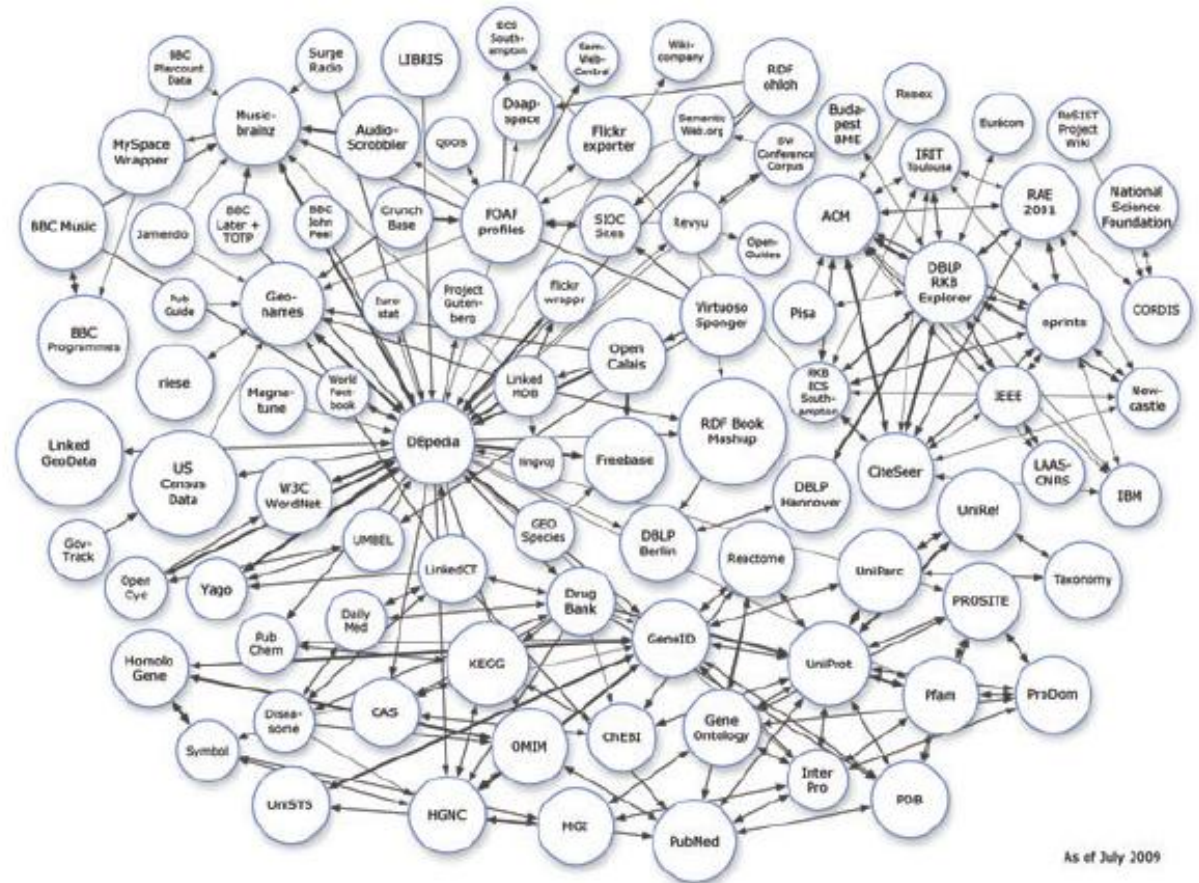
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- Use of state-of-the-art information and communication technology (ICT) to prevent researchers from having to rediscover information already known by;
  - fostering collaboration
  - enabling reuse, curation and expansion of datasets and knowledge.

## **Industrial Ecology 2.0**

# Information and Communication Technology

- Wikis linked as open data cloud that can be queried



**Figure 2** The Linked Open Data Cloud. Circles represent sources that publish information using Semantic Web standards. Edges indicate that two sources contain information about the same concept, and that an explicit link has been made, similar to how one would include a link from their own Web page to another Web page (Cyganiak 2009). Used with permission granted by the Creative Commons License (<http://creativecommons.org/licenses/by-sa/3.0/>). 23

# Information and Communication Technology

- Wikis linked as open data cloud that can be queried
- Sourcing of published data enabled by using semantic web standards and resource description framework (RDF)

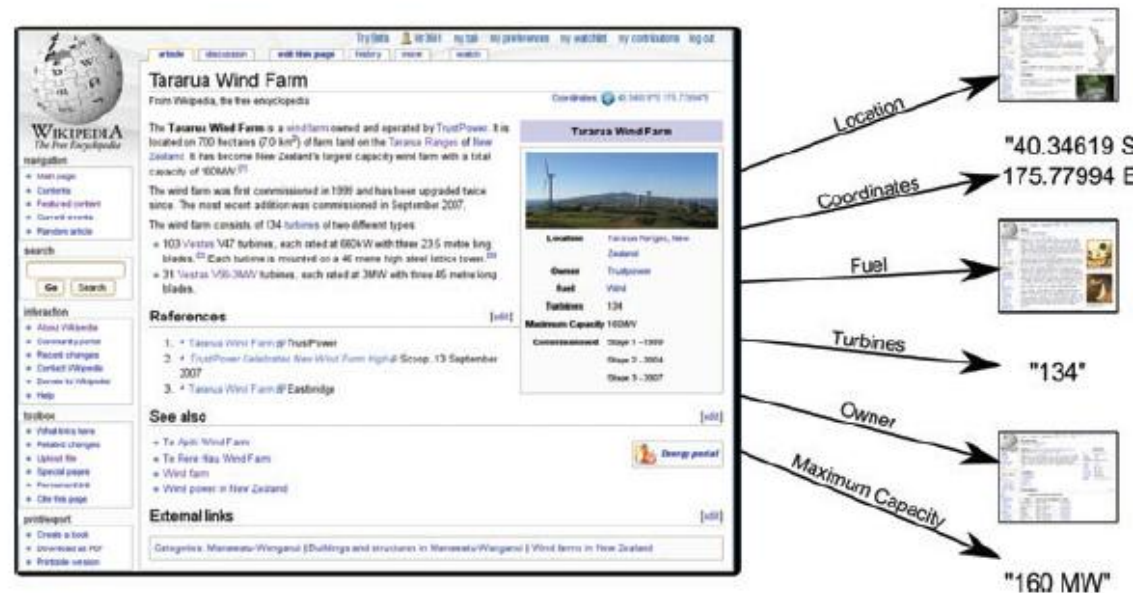


Figure 1 Example of structured information on Wikipedia.

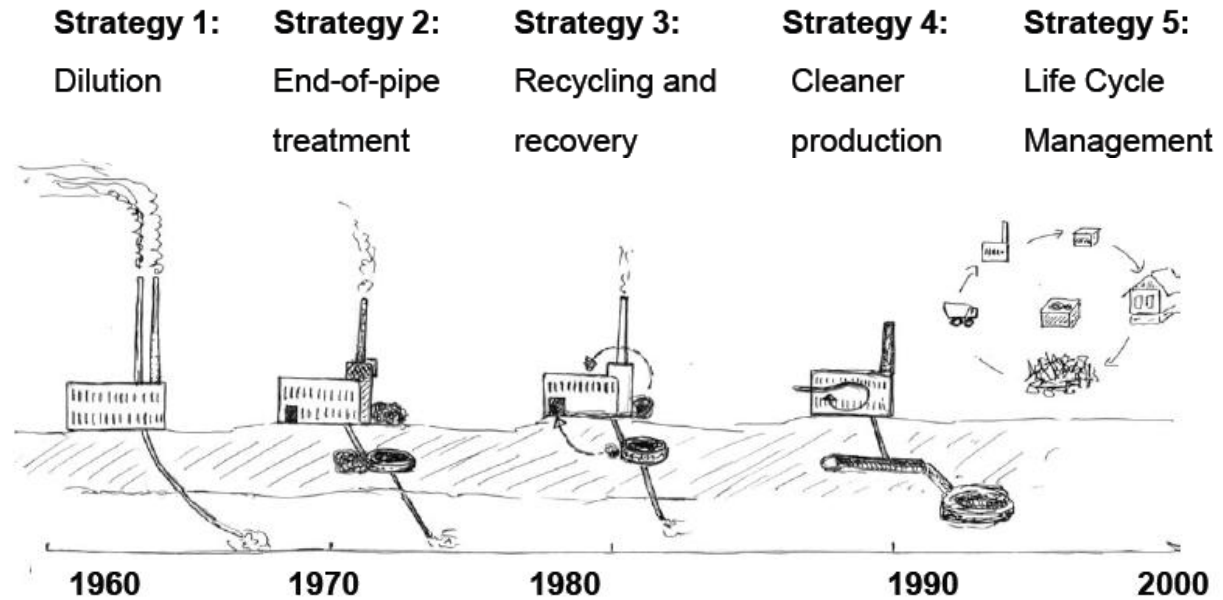


*“Information technology has empowered civil society to be the true guardians of democracy and good governance everywhere. In a sense, [civil society] has been the new superpower – the people determined to promote better standards of life in larger freedom.”*

Kofi Annan

Former UN Secretary-General





United Kingdom  
United States  
South Korea  
Japan

# Evolution of Environmental Management

1950

1960

1970

1980

1990

2000

2010

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